CLAIMS

The invention claimed is:

1. A method of forming a monolayer of functionalized silicon on a substrate surface, the functionalized silicon including an organic group covalently attached with the silicon, the method comprising exposing the substrate surface to a precursor comprising the functionalized silicon under a pressure of at least 30 psi, the precursor interacting with the substrate to form the monolayer across at least a portion of the surface of the substrate.

2. The method of claim 1 wherein the exposing of the substrate surface to the precursor molecules occurs in a supercritical fluid.

3. The method of claim 1 wherein the pressure is at least 100 psi.

4. The method of claim 1 wherein the pressure is at least 1000 psi.

5. The method of claim 1 wherein the pressure is at least 4000 psi.

6. The method of claim 1 wherein the pressure is at least 8000 psi.

7. The method of claim 1 wherein the substrate comprises glass.

8. The method of claim 1 wherein the substrate comprises a glass fiber; and further comprising, after forming the monolayer, incorporating the glass fiber into a fiberglass matrix by bonding the organic group within a polymeric material.

9. The method of claim 1 wherein the substrate comprises aluminum, and the substrate surface comprises oxygen of aluminum oxide.

10. The method of claim 1 wherein the substrate comprises a silicon wafer, and the surface comprises oxygen of silicon dioxide.

11. The method of claim 1 wherein the substrate surface predominately comprises carbon.

12. The method of claim 1 wherein the substrate surface comprises silicon carbide.

13. The method of claim 1 wherein the substrate comprises titanium, and the substrate surface comprises oxygen of titanium oxide.

14. The method of claim 1 further comprising forming a film of water across a surface of the substrate prior to the exposing of the substrate to the precursor.

15. The method of claim 1 wherein the precursor is selected from the group consisting of siloxanes, silazanes and chlorosilanes.

16. The method of claim 1 wherein the exposing of the substrate surface to the precursor molecules occurs for a time of at least about 10 seconds.

17. The method of claim 1 wherein the exposing of the substrate surface to the precursor molecules occurs for a time of at least about 30 seconds.

18. The method of claim 1 wherein the exposing of the substrate surface to the precursor molecules occurs for a time of at least about minute.

19. A method of functionalizing a porous material, comprising exposing the porous material to precursor molecules, the precursor molecules comprising core atoms from which crosslinking atoms and functional groups extend; the porous material being subjected to a pressure of at least 30 psi during the exposing, the precursor interacting with the material to form a monolayer across at least a portion of a surface of the material, the monolayer layer comprising the functional groups.

20. The method of claim 19 wherein the exposing of the porous material to the precursor molecules occurs in a supercritical fluid.

21. The method of claim 19 wherein the precursor molecules are selected from the group consisting of siloxanes, silazanes, chlorosilanes, metal phosphate, hydroxamic acid, carboxylate, thiol, amine and combinations thereof.

22. The method of claim 19 wherein the porous material is a mesoporous material, and wherein the monolayer forms within pores of such material having maximum widths of 50 nanometers or less.

23. The method of claim 22 wherein the monolayer within the pores is at least 70% fully crosslinked.

24. The method of claim 19 wherein the porous material is a zeolite, and wherein the monolayer forms within pores of the zeolite.

25. The method of claim 24 wherein the monolayer within the pores is at least 70% fully crosslinked.

26. The method of claim 19 wherein the pressure is at least 100 psi.

27. The method of claim 19 wherein the pressure is at least 1000 psi.

28. The method of claim 19 wherein the pressure is at least 4000 psi.

29. The method of claim 19 wherein the pressure is at least 8000 psi.

30. A method of functionalizing an oxygen-containing surface, comprising exposing the surface to precursor molecules, the precursor molecules comprising core atoms from which crosslinking atoms and functional groups extend; the surface being subjected to a pressure of at least 30 psi during the exposing, the precursor interacting with the oxygen of the oxygen-containing surface to form a monolayer across at least a portion of the surface, the monolayer layer comprising the functional groups.

31. The method of claim 30 wherein the exposing of the oxygen-containing surface to the precursor molecules occurs in a supercritical fluid.

32. The method of claim 30 wherein the core atoms are silicon.

33. The method of claim 32 wherein the precursor molecules are selected from the group consisting of siloxanes, silazanes and chlorosilanes.

34. The method of claim 30 wherein the pressure is at least 100 psi.

35. The method of claim 30 wherein the pressure is at least 1000 psi.

36. The method of claim 30 wherein the pressure is at least 4000 psi.

37. The method of claim 30 wherein the pressure is at least 8000 psi.

38. The method of claim 30 wherein the surface is a glass surface.

39. The method of claim 30 wherein the surface is a surface of a glass fiber; and further comprising, after forming the monolayer, incorporating the glass fiber into a fiberglass matrix by bonding the organic group within a polymeric material.

40. The method of claim 30 wherein the surface is a surface of aluminum oxide.

41. The method of claim 30 wherein the surface is a surface of silicon dioxide.

42. The method of claim 30 wherein the surface is a surface of titanium oxide.

43. A method of functionalizing a carbon-containing surface, comprising exposing the surface to precursor molecules, the precursor molecules comprising core atoms from which crosslinking atoms and functional groups extend; the surface being subjected to a pressure of at least 30 psi during the exposing, the precursor interacting with the carbon-containing surface to form a monolayer across at least a portion of the surface, the monolayer layer comprising the functional groups.

44. The method of claim 43 wherein the exposing of the carbon-containing surface to the precursor molecules occurs in a supercritical fluid.

45. The method of claim 43 wherein the core atoms are silicon.

46. The method of claim 43 wherein the precursor molecules are selected from the group consisting of siloxanes, silazanes and chlorosilanes.

47. The method of claim 43 wherein the pressure is at least 100 psi.

48. The method of claim 43 wherein the pressure is at least 1000 psi.

49. The method of claim 43 wherein the pressure is at least 4000 psi.

50. The method of claim 43 wherein the pressure is at least 8000 psi.

51. The method of claim 43 wherein the surface predominately comprises carbon.

52. The method of claim 43 wherein the surface consists of carbon.

53. The method of claim 43 wherein the surface comprises silicon carbide.

54. The method of claim 43 further comprising forming a film of water across the surface prior to the exposing of the surface to the precursor.

55. The method of claim 43 wherein the surface is part of a carbon fiber substrate.

56. The method of claim 43 wherein the surface is part of a carbon black substrate.